Lessons in Tackling IDE Performance

Pablo Baxter

September 22, 2023
Why we care about the IDE

- IDE is the "last mile" (and often neglected?) of the developer experience!
- We couldn't find easily digestible information on the Internet about this topic.
- Hope you'll be able to use this knowledge to help improve the IDE experience for everyone!
Quick History
In October 2019, we standardized on Android Studio and Gradle.

We also decide to pursue code modularization. (Look up Ralf Wondratschek’s “Android at Scale @Square”, Droidcon’19)

- Module count: ~1200
- Over the next few years, sync times worsened as our Gradle subprojects increased.
  - Module count: ~3500

- Google and Gradle start to prioritize sync times on Android Studio.
Google and Gradle start to prioritize long sync times

Standardize Gradle/Android Studio. Modularize android projects.

December 2020

Google and Gradle start to prioritize long sync times

July 2021

Arctic Fox Release

• Android Studio Arctic Fox released!

• Did not help with sync times as we had hoped
  ○ Module count: ~4000
Google and Gradle start to prioritize long sync times

October 2019

Block

December 2020

Google and Gradle start to prioritize long sync times

November 2020

Standardize Gradle/Android Studio. Modularize android projects.

July 2021

Arctic Fox Release

July 2021

Android Studio also starts to become unusable

July 2022

Android Studio also starts to become unusable for some developers

- Pablo Baxter joins Block!
  - Module count: ~4600
Problem #1: IDE freezes

- Developers began to complain that their IDE was unresponsive.
- This problem seemed to be so debilitating that people couldn't do their work.
- AGP v7.3 deprecated the “package” tag, “namespace” was going to be required.
Inspecting the logs

- Noticed a particular message that seemed to be flooding the IDE.


- Found a related Google ticket and asked about it.

- Reverted the change because the Android Studio wasn't quite ready for the AGP update.

https://issuetracker.google.com/issues/231704909
Lessons

- The Android toolchain (AGP, Android Studio, Gradle) are often evolving independently.

- Ask your engineers for IDE logs when there are issues, especially if they are playing with canary versions.

- First exposure to understanding how these tools interact.
Problem #2: IDE Sync wasn't finishing

- Sync process seemed to be stalled.
- Gradle consuming too much memory on our laptops.
- Seemed to be showing up in canary versions only.
Chasing a memory leak

- Captured a heap dump and sent to py@
- Couldn't recompile Android Studio but realized we could byte-code patch it
- Retested with recompiling IntelliJ from source as well!
@Block gavra@google.com

```java
@-111,12 +111,7 @ public AllModels execute(final BuildController controller) {
    myParallelModelsFetch = Boolean.getBoolean(IDEA_MODELS_PARALLEL_FETCH);
    if (!System.getProperties().containsKey(IDEA_BACKGROUND_CONVERT) ||
        Boolean.getBoolean(IDEA_BACKGROUND_CONVERT)) {
        return null;
    }

    myConverterExecutor = Executors.newSingleThreadExecutor(new ThreadFactory() {
        @Override
        public Thread newThread(@NotNull Runnable runnable) {
            return new Thread(runnable, "idea-tooling-model-converter");
        }
    });
    configureAdditionalTypes(controller);
    final boolean isProjectsLoadedAction = myAllModels == null &&
        myUseProjectsLoadedPhase;

    @-717,4 +712,11 @ public Object convert(Object object) {
        return object;
    }
}

private static final class SimpleThreadFactory implements ThreadFactory {
    @Override
    public Thread newThread(@NotNull Runnable runnable) {
        return new Thread(runnable, "idea-tooling-model-converter");
    }
}
```
public static ExecutorService newSingleThreadExecutor() {
    return new FinalizableDelegatedExecutorService
        (new ThreadPoolExecutor(1, 1,
        0L, TimeUnit.MILLISECONDS,
        new LinkedBlockingQueue<Runnable>(())));
}

static class FinalizableDelegatedExecutorService
        extends DelegatedExecutorService {
    FinalizableDelegatedExecutorService(ExecutorService executor) {
        super(executor);
    }

    protected void finalize() {
        super.shutdown();
    }
}
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We discover a memory leak in Electric Eel!

PY talks about this memory in his blog
- [https://blog.p-y.wtf/gradle-intellij-memory-leak](https://blog.p-y.wtf/gradle-intellij-memory-leak)

Roger Hu provides walkthrough on how to do bytecode patch using Recaf
Lessons

- Heap dumps are needed for tracking down memory issues.

- There are multiple places where problems can occur (Gradle daemon, IDE plugin, IDE code)

- Android Studio and IntelliJ are not that dissimilar

- Learned about bytecode patching JAR files with Recaf

- Thanks to Tony, PY and Roger for this fix!
  - [https://github.com/JetBrains/intellij-community/pull/2186](https://github.com/JetBrains/intellij-community/pull/2186)
Problem #3: IDE freezing again

- Memory leak eliminated!
- Namespace migration reverted!
- Now what?
What if we could debug IDE?

- Android Studio code isn't easily compilable (Bazel, internal libraries).
- Figured out we could do it with using IntelliJ open source
- Figured out how to attach breakpoints between Gradle or the IDE
How to attach a debugger for the IDE code to Gradle daemon
How to:

- Open the project you wish to debug
- Ensure the correct version is used

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- Start your Gradle task to debug with debugger flags

https://docs.gradle.org/current/userguide/command_line_interface.html#sec:command_line_debugging
How to debug IDE process:

- Roger Hu provided great walkthrough
Back to debugging problem #3

- Debugging showed call stack that repeated calls to the same function constantly

- IDE logs showed this same stacktrace in the thread dumps which are triggered when a UI freeze occurs

- Eventually found that ProjectFacetManagerImpl.getFacets() was excessively called
Back to debugging problem #3

- Debugging showed call stack that repeated calls to the same function constantly
- IDE logs showed this same stacktrace in the thread dumps which are triggered when a UI freeze occurs
- Eventually found that ProjectFacetManagerImpl.getFacets() was excessively called

https://issuetracker.google.com/issues/248576926
How Google solved it

- Added a caching layer mapping package names to AndroidFacet objects
- Prevents allocation of thousands of arrays that each have thousands of elements each time the compiler front-end ran.
- Thank you Ivan Gavrilovic, Xavier Ducrohet, and team
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Electric Eel released!

- [https://newsletter.gradle.org/2023/01](https://newsletter.gradle.org/2023/01)
- [https://android-developers.googleblog.com/2023/01/android-studio-electric-eel.html](https://android-developers.googleblog.com/2023/01/android-studio-electric-eel.html)
Lessons

- Debugging IDE code in both the Gradle and IDE processes
- IDE and Gradle source codes “intermingle”
- A well written bug report to the right group goes a long way
Questions?
Thank You